CENWP-EC-HR (Sediment Quality Team) 28 January 2016

Memorandum for the Record: Bonneville Dam, Bradford Island Fish Ladder (BIFL) Exit Dredging Project dredged material evaluation history and suitability determination.

Project Description: The BIFL is located on Bradford Island and has two entrances directly downstream of the Bonneville Dam – one on the north side of the island and one on the south side. The north and south fish ladders merge into one fish ladder, transiting by the Bradford Island Visitor Center. The BIFL exits into the south forebay of the Bonneville Dam.

Sediment and debris create shoals at the BIFL exit, and periodic maintenance dredging is needed to keep the fish ladder exit open. In the past, dredge quantities have ranged from approximately 650 cubic yards (cy) to a maximum of 2,000 cy. The BIFL exit dredging proposed for 2016 is essentially the same as occurred in 2012.

Site History Information:

BIFL Exit Dredging History: In January/February 2002, approximately 1,600 cy of sediment and debris were dredged with a clamshell from the BIFL exit. Although the material was determined to be suitable for unconfined, aquatic disposal, it was placed on a barge and transported to the RABANCO Regional Disposal Company's facility in Roosevelt Washington.

In February 2012, approximately 650 cy of sediment and debris were dredged with a clamshell dredge from the BIFL shoal, dewatered on Bradford Island in the upland, and transported by dump truck to an approved landfill.

1997 and 2001 BIFL Sampling Events: Sediment sampling prior to 2007 is summarized in the June 2007 "Sediment Sampling & Analysis Plan: Bonneville Dam, Bradford Island Fish Ladder" (SAP, Attachment A). The shoaling material at the BIFL was determined to be suitable for aquatic placement in 1997 and in 2001.

2007 BIFL Sampling Event: On 31 July 2007, the Sediment Quality Team collected 3 sediment samples to characterize a 2,000 cubic yard (cy) shoal adjacent to the Bradford Island Fish Ladder (BIFL). Four years later, the Sediment Quality Team summarized the sediment quality data in the July 2011 "Bonneville Bradford Island Fish Ladder Sediment Quality Evaluation Report" (SQER, Attachment B).

The SQER was submitted to the interagency Portland District Project Review Group (PRG; now known as the Portland Sediment Evaluation Team[1]) for evaluation per the Northwest Regional Sediment Evaluation Team's (RSET's) 2009 Sediment Evaluation Framework for the Pacific Northwest (SEF). The SEF is used by the PRG/PSET to evaluate the suitability of dredged material for unconfined, aquatic disposal, as required under the Clean Water Act section 404(b)(1) guidelines (see 33 CFR 230.60-230.61).

[1] The PRG/PSET agencies include the Portland District (Lead), Environmental Protection Agency-Region 10 (Co-Lead), National Marine Fisheries Service, U.S. Fish and Wildlife Service, Washington Department of Ecology, and Oregon Department of Environmental Quality.

The PRG compared sediment quality data presented in the SQER to the freshwater benthic toxicity screening levels (SLs) published in the RSET's 2006 Interim Final SEF (freshwater SLs were not published in the 2009 SEF). Total mercury concentrations at the BIFL averaged *0.362 mg/kg* (range *0.319 mg/kg* to *0.402 mg/kg*), exceeding the SEF screening level of **0.28 mg/kg**. On 29 July 2011, the PRG issued a negative suitability determination memorandum to the District stating that sediments in the 2,000 cy shoal were not suitable for unconfined, aquatic disposal (Attachment C).

PacifiCorp Condit Dam Removal Project: On 28 October 2011, the Condit Dam was breached by PacifiCorp to restore fish passage on the White Salmon River. The White Salmon R. discharges into the Bonneville Pool at Underwood, WA (Columbia River Mile 168.3), approximately 23 miles upstream of Bonneville Dam. Sediments stored in Northwestern Lake were characterized prior to the dam removal; total mercury (Hg) concentrations ranged from *0.094 mg/kg* to *0.881 mg/kg* (average Hg conc. = *0.60 mg/kg*) (Kleinfelder, 2008).

Between 1.6 and 2.2 million cy of Hg-contaminated, fine-grained sediment was discharged down the White Salmon R. into the Bonneville pool. Although sediment concentrations exceeded the 2006 Hg SL (**0.28 mg/kg**), the discharge was permitted, because the benefits of the stream and fish habitat restoration project outweighed the potential detrimental effects of releasing Hg-contaminated sediment into the system.

Kleinfelder et al. (2012) conducted one round of pre-dam removal sediment sampling (September 2011) and two rounds of post-dam removal sediment sampling (November 2011 and September 2012) were conducted at four locations on the Columbia River:

- On the Washington side of the Columbia R., across from Cascade Locks, OR, downstream of the White Salmon R.
- At the Wind R. confluence (Carson, WA), downstream of the White Salmon R.
- At the White Salmon R. confluence (Underwood, WA)
- At the Klickitat R. confluence (Lyle, WA), upstream of the White Salmon R.

Grain size analysis indicated that fine-grained sediment (silt + clay) was transported and deposited downstream of the White Salmon R. after the dam removal. Hg concentrations increased by 0.02 mg/kg at the Cascade Locks sampling location between September 2011 and September 2012 (from *0.07 mg/kg* to *0.09 mg/kg*). Hg concentrations at the Wind R. sampling location decreased slightly by 0.01 mg/kg (from 0.03 mg/kg to 0.02 mg/kg). These differences are not significant, because they are within the range of laboratory analytical variability. At the mouth of the White Salmon R., total Hg concentrations decreased by 0.08 mg/kg between September 2011 and September 2012 (from *0.98 mg/kg* to *0.90 mg/kg*).

Management Area Rank and Testing Frequency: Per the SEF, projects are assigned a management area rank based on risk of contamination in the project area. The PRG assigned a "moderate" rank to the BIFL exit dredging project based on the July 2007 SQER. Associated with the project rank is a sediment testing frequency: moderate-ranked projects must be re-characterized 5 years after the prior round of characterization (i.e., by July 2012) to support aquatic disposal of the dredged material.

Discussion: In-situ sediment testing is not required to support dredging and upland placement of the BIFL exit shoal material. However, the receiving landfill will likely require a leachate analysis prior to accepting the material. If aquatic disposal of the dredged material is proposed in the future, then in-situ sediment characterization will be necessary prior to dredging. The District does not anticipate that water quality criteria will be exceeded during the dredging operation. A discussion of these concepts follows.

Dredged Material Suitability (Aquatic Disposal): The BIFL exit shoal material is ***not suitable for unconfined, aquatic disposal*** without additional characterization. Although the RSET's updated Hg SL is **0.66 mg/kg**, and the 2007 Hg concentrations measured in the BIFL shoal (*0.319 mg/kg* to *0.402 mg/kg*) are less than the new SL, the 2007 data cannot be compared to the 2015 SLs to support aquatic placement of the BIFL exit shoal material because:

- The Condit Dam removal has changed conditions by contributing Hg-contaminated sediment to the system; additional sediment sampling would be needed to augment the 2007 data.
- Per the SEF management area rank and testing frequency guidelines, the July 2007 data have "expired;" additional sediment characterization would be necessary.

Dredged Material Suitability (Upland Disposal): ***Once a landfill has been identified, the project manager should coordinate with the landfill to determine the necessary testing requirements.*** Based on past experience, the landfill will likely require a toxicity characteristic leachate procedure (TCLP) analysis for 8 heavy metals (arsenic, barium, cadmium, chromium, lead, mercury, selenium, and silver). Polychlorinated biphenyls were not identified as a chemical of concern in the last two rounds of characterization (2001 and 2007). However, due to the history of PCBs contamination at Bradford Island, a TCLP analysis may also be required for PCB Aroclors. The dredging contractor can collect subsamples of dredged material during the dredging operation and submit a composite sample to an environmental laboratory for the TCLP analysis.

Hg and Water Quality in the Dredge Area: The 2009 SEF provides freshwater elutriate test triggers (ETs) for metals and some organic compounds. ETs provide an initial screening evaluation to determine if dredging would result in state water quality criteria being exceeded. If dredged sediment concentrations are below the ETs, then the dredged material is not expected to cause adverse water quality effects at the point of dredging. The Hg ET for freshwater sediment is 279 mg/kg. Total Hg concentrations in the project area sediments and the sediments released from behind Condit Dam are 3 to 4 orders of magnitude less than the freshwater Hg ET. The SEF freshwater ET calculations and ET tables appear in Attachment D.

Contact: Questions regarding this memorandum and its content can be addressed to James McMillan (PSET Lead; email: james.m.mcmillan@usace.army.mil; tel.: 503.808.4376).

References:

Kleinfelder; Ellis Ecological Services, Inc.; and JR Merit Industrial Contractors. 2012. "Condit Hydroelectric Project Decommissioning (FERC Project No. 2342) – September 2012 Year 1 Sediment Sampling Report." *Prepared for* PacifiCorp Energy (14 December).

Kleinfelder, 2008. “Updated Evaluation of Mercury Bioaccumulation, Underwood In Lieu Fishing Access Site, Northwestern Lake, Condit Hydroelectric Project.” FERC Project No. 2342, White Salmon, Washington (4 December).

U.S. Army Corps of Engineers, U.S. Environmental Protection Agency, Washington Department of Ecology, Washington Department of Natural Resources, Oregon Department of Environmental Quality, Idaho Department of Environmental Quality, National Marine Fisheries Service, and U.S. Fish and Wildlife Service. 2009. *Sediment Evaluation Framework for the Pacific Northwest*. Published May 2009, by the U.S. Army Corps of Engineers, Northwestern Division, 128 pp + Appendices.

ATTACHMENT A

Sediment Sampling & Analysis Plan: Bonneville Dam, Bradford Island Fish Ladder

June 2007

SEDIMENT
SAMPLING & ANALYSIS PLAN

BONNEVILLE DAM
BRADFORD ISLAND FISH LADDER

JUNE 2007

Prepared by:
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Technical Review:
Mark Siipola

Portland District
Corps of Engineers
CENWP-EC-HR

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ACRONYMS

Ag	Silver
As	Arsenic
Cd	Cadmium
CoC	Contaminate of concern
Cu	Copper
DEQ	Oregon Department of Environmental Quality
DMEF	Dredge Material Evaluation Framework
DQO	Data Quality Objectives
EPA	Environmental Protection Agency
Hg	Hg
MDL	Method Detection Limit
NES	Newly Exposed Surface
Ni	Nickel
PAH	Polynuclear Aromatic Hydrocarbon
Pb	Lead
PCB	Polychlorinated Biphenyl
QA/QC	Quality Assurance/Quality Control
SAP	Sampling and Analysis Plan
Sb	Antimony
SL	Screening Levels
TEL	Threshold Effects Level
TOC	Total Organic Carbon
USFWS	U. S. Fish & Wildlife Service
Zn	Zinc

1. PROJECT OVERVIEW

1.1. Project Site Location and Description

Bonneville Dam is located between River Mile (RM) 145 and 146 of the Columbia River. The proposed dredge site is located at the fish exit (water entrance) of the fish ladder east of the Bonneville Dam First Powerhouse on the south side of Bradford Island. Approximately 2000 CY or less will be dredged by clam shell. Pending a suitability determination, material will be placed in a dispersive flowlane area below the dam. If not determined suitable for in-water disposal, material will be placed in an approved upland disposal site.

1.2. Previous Sediment Sampling

In 1991 informational sampling and analysis was done on sediment downstream from the First Powerhouse Navigational Lock, on the south side of the river, with results acceptable for unconfined in-water or upland disposal. This same downstream area was dredged in1986 and in the late 1970s.

In July 1997 seven sediment samples were collected from Bonneville Second Powerhouse forebay and water supply conduits. Two of the samples were taken from the downstream portion of the south Auxiliary Water Supply (AWS) conduit by divers inspecting the inside of the south AWS. Three additional samples were taken from the surface of the sediment deposits at the north end of the forebay. The final two samples were collected from the sediment and woody debris removed from the north AWS intake trash rack by clamshell and stockpiled on Cascade Island, at the south end of the Elevation 90 Deck crane way extension. Physical analysis, run on four sediments, indicated the material ranges from gavel to very fine sand, with largest fractions in the coarse to medium sand range. Chemical analysis, run on five sediments, included metals, pesticides/polychlorobiphenyls (PCBs), polynuclear aromatic hydrocarbons (PAHs), total organic carbon (TOC), acid volatile sulfide (AVS), phenols and dioxin screen (P450). The portion of the sample submitted to the lab was representative of the material dredged, except for the woody debris. Results determined the material to be acceptable for unconfined in-water or upland disposal.

Beginning in May 2001 sediment samples were taken from an area at the Northeast end of Bradford Island, which contained high levels of PCBs from discarded electrical components discovered in the near shore area. Since the initial sampling event, several rounds of samples have been collected, both from in-water and upland areas. All discarded electrical components have been removed from the water. The investigation of this former dumpsite is still in progress. Currently a sampling plan has been developed to further analyze sediments and both benthic and aquatic organisms.

In December 2001 three (3) sediment samples were collected from the fish ladder exit. The samples were collected using a ponar sampling device (a gravity core sampler was tried, but had only about 12” penetration). All samples were submitted for physical analyses including total volatile solids (TVS) and were analyzed for metals (9 inorganic), total organic carbon (TOC),

pesticides and polychlorinated biphenyls (PCBs), phenols, phthalates, miscellaneous extractables, polynuclear aromatic hydrocarbons (PAHs) and organotin (TBT).

None of the laboratory data results exceeded their respective screening levels in the DMEF. Levels of DDT and its derivatives (DDD & DDE) were found in all three of the samples at levels ranging from 6.39 to 6.78 ug/kg (ppb), but did not exceed the 6.9 ug/kg DMEF screening level. All sediment is determined to be suitable for unconfined, in-water placement or suitable upland placement with return water without further characterization under guideline of the DMEF.

Although the 1577 CY of material dredged was determined to be suitable for unconfined in-water placement, it was determined, as a management option, to barge the material to RABANCO Regional Disposal Company's facility in Roosevelt Washington.

1.3. Current Project Characteristics

The current need for dredging is much the same as it was previously in 2001. Sediment has accumulated at the fish ladder (fish exit area) on the south side of Bradford Island, hampering the optimal function of the facility.

2. PROJECT OBJECTIVES, PLANNING, AND LOCATION

2.1. Objectives

- Characterize sediments in accordance with the regional dredge material testing manual protocols:
    - Sediment Evaluation Framework (SEF), 2006.
    - The Evaluation of Dredged Material Proposed for Disposal at Island, Nearshore, or Upland Confined Disposal Facilities – Testing manual (Upland Testing Manual).

- Collect, handle and analyze representative sediment from Bradford Island Fish ladder exit (water entrance) in accordance with protocols and Quality Assurance/Quality Control (QA/QC) requirements.

- Characterize sediments to be dredged for evaluation of suitability of in-water disposal.

- Analyze for full suite of physical and chemical parameters as outlined in the SEF (2006). SEF – Table 7.2 (Appendix C of this report) contains the list of analytes and methods of analysis. Organotin will not be considered an in-water contaminate of concern at the fish ladder; results from the 2001 sediment sampling event indicate it is not present above detection limits.

2.2. Planning Team and Responsibilities

Table 1 lists the Project Team's duties and responsibilities for the sediment-sampling project at Bradford Island Fish ladder.

Table 1: Planning Team and Responsibilities

Task/Responsibility	CENWP Tim Sherman	Columbia Analytical Services	CENWP Personnel	CENWP Mark Siipola
Overall Project Management	X			
Sampling Plan Development	X			
Agency Coordination	X			X
Positioning/Log Record	X		X	
Sediment Sampling	X		X	
Physical Analysis	X			
Chemical Analysis	X	X		
Final Report	X			
Technical Review				X
Boat & Operator	X			

2.3. Location

Table 2 lists the proposed sampling coordinates within the Bradford Island Fish ladder exit area. Coordinates are based on the Lambert Projection for Oregon; North Zone (NAD 83, U.S. Survey Feet).

Table 2: Proposed Sampling Station Coordinates (NAD 83)

Sample Id	Latitude	Longitude
060507BIFL-P-01	45º 38.462'	121º 56.572'
060507BIFL-P-02	45º 38.460'	121º 56.539'
060507BIFL-P-03	45º 38.430'	121º 56.528'

3. SAMPLING AND ANALYSIS REQUIREMENTS

3.1. Ranking

This area has not been ranked, but is in relatively close proximity to a contaminated site on the north side of Bradford Island. Although the 2001 sampling event showed that material suitable for in-water placement, additional sampling will be conducted.

3.2. Sampling Requirements

Sampling requirements depend on the type of sediment (heterogeneous or homogeneous), grain-size, organic content, the level of contamination (ranking in the SEF), depth of dredging prism and the need to characterize the new surface material after dredging. Three discrete samples will be collected and analyzed for PCBs. However, prior to analyses the 3 master samples will be split in the field. Procedure for splitting sample as follows: master sample will be mixed in clean stainless steel container, after mixing sample will be laid out on a clean surface and quartered. The 2 opposing quarters will be placed in one jar and the other 2 quarters in the jar to be archived (frozen) at the lab for possible future analyses. At the laboratory, sample to be analyzed should be mixed and placed on a clean surface and a pie shaped segment selected for analysis. This assures that settling during shipment and storage does not affect segment analyzed.

3.3. Sampling Device

A ponar sampler will be used to sample the sediment material. In the 2001 sampling event a gravity-core sample was attempted, with only 1-foot of penetration achieved it was not deemed necessary to attempt further gravity cores and a ponar was used to collect the additional 2 samples. This effort will include the collection of three (3) samples at the fish exit of the ladder. The depth of the dredge prism is less than 3-feet and contains all infill material since the last dredging activity. Proposed sampling locations are shown in Figures 2 and station coordinates in Table 2. Physical and chemical characterization analyses will be performed on all samples.

- Samples will be shipped to Columbia Analytical Services for analyses
- Turn-around-Time (TAT) will be standard 20 calendar days from laboratory receipt of samples
- Sample detection limits are those listed in SEF, 2006, Table 7.2 (see appendix C).

4. SAMPLE COLLECTION AND HANDLING PROCEDURES

4.1. Sampling Locations and Numbering

Figure 1 shows the project area vicinity map with approximate sample locations. Sampling sites are located for the best characterization of the material within the dredging prism as possible. Proper QA/QC procedures as outlined in this section will be followed. Any deviation from these procedures shall be noted in the field log. Sample identification shall use the following convention:

060507BIFL-X-YY

where:

- 060507 denotes the sampling date (June 5, 2007).
- “BIFL” denotes samples collected from the Bradford Island Fish ladder.
- “X” denotes the type of sampling device (i.e. “P” for “Ponar”).

- "YY" denotes the numeric sample sequence number. All samples will consist of two digits.

QC replicates (if collected) will have a letter designation in place of the numeric designation of the primary sample (i.e. 060507BIFL-X-A). Duplicate samples (if collected) will be identified in the field notes. Composite samples (if collected) will have a combined number in the "YY" designation (i.e. sample 02 and 03 will be 023, etc.).

4.2. Field Sampling Schedule

The Bradford Island Fish Ladder sampling event is schedule for July 31, 2007. This date is dependent on the ability to coordinate all required services prior to this date.

4.3. Field Notes

Field notes will be maintained during sampling and compositing operations. The following, as a minimum, will be included:

- Name of personnel(s) collecting and logging samples.
- Weather conditions.
- Date and time of collection of each sediment sample.
- Depth of each station sampled as measured from the water surface. This will be accomplished using a lead-line or corrected depth recorder.
- Sample station number and individual designation numbers assigned for each individual sample.
- Descriptions of sediment or core sections.
- Length and penetration depth of sampling device if sample is a core.
- Any deviation from the approved sampling plan.
-

4.4. Positioning

Sampling locations will be recorded in the field to the nearest 0.1 second. Coordinates are based on the Lambert Projection for Oregon – North Zone (NAD83, U.S. Survey feet). See Table 2 in Section 2.3 for coordinates of sampling points.

4.5. Decontamination

All sampling devices and utensils will be thoroughly cleaned prior to use as outlined below:

- Rinse with site water, to remove sediment.
- Wash with brush and Alconox soap.
- Rinse with distilled water.

Utensils used to collect physical samples only or sampling devices such as the surface grab will be washed down before each sampling event. They will not, however, require the cleaning procedure outlined above as long as samples collected for chemical analyses are not in contact with core walls. All utensils used to collect chemical samples will require decontamination prior to each use. All hand work for chemical analyses will be conducted with disposable latex gloves and shall be rinsed with distilled water before and after handling each individual sample, as appropriate, to prevent sample contamination. Gloves will be disposed of between each sample or composite to prevent cross-contamination.

4.6. Core Logging

If used, each discrete core section will be inspected and described. For each core sample, the following data shall be recorded on the core log:

- Sample recovery.
- Physical soil description (including soil type, density/consistency of soil, and color),
- Odor (e.g. hydrogen sulfide, petroleum products, etc.).
- Visual stratification and lenses.
- Vegetation.
- Debris.
- Biological activity (e.g. detritus, shells, tubes, bioturbation, live/dead organisms, etc.).
- Presence of oil sheen.
- Any other distinguishing characteristics or features.

4.7. Field Compositing

No samples will be composited. Three (3) Ponar surface samples shall be collected from the Bradford Island Fish Ladder exit area and analyzed for physical and chemical contaminates as described in section 5 below.

4.8. Field Replicates

No blind duplicate field replicate will be submitted. Laboratory QC shall be used to evaluate and access data quality. Three discrete samples will be collected and analyzed for PCBs. However, prior to analyses the 3 master samples will be split in the field.

4.9. Sample Transport and Chain-of-Custody Procedures

Upon completion of sampling, sample containers shall be packed in ice or "blue ice" in coolers to maintain an arrival temperature of 4º C ± 2ºC. Chain-of-custody procedures shall commence in the field and track delivery of samples. Sample holding times and storage requirements are presented in Table 3. Specific procedures are as follows:

- Samples shall be packaged and shipped in accordance with U.S. Department of Transportation regulations as specified in 49 CFR 173.6 and 49 CFR 173.24 or delivered directly to the testing laboratory.
- Individual sample containers shall be packed to prevent breakage.
- Coolers shall be clearly labeled with sufficient information to enable positive identification. As a minimum, the following is required:
    - Name of project.
    - Time and date container was sealed.
    - Personnel sealing cooler.
    - Office name and address.
- Custody seals shall be used on cooler(s) during shipment.
- Chain-of-custody forms shall be enclosed in a plastic bag and placed inside cooler. Upon transfer of sample possession to laboratory, personnel transferring custody of coolers shall sign the chain-of-custody form. Personnel receiving cooler shall inspect the cooler(s) and record the condition of the samples.

Table 3: Sample Volume and Storage

Hold times indicated in this table are those recommended by EPA prior to extraction. Samples may be archived by freezing or stored under nitrogen to extent the hold time before extraction up to 1-year. Extracts may be stored up to 40-days before analysis.

Sample Type	Holding Time	Sample Size (a)	Temperature (b)	Container
Particle Size	6 Months	200 g	4º±2ºC	1-1 Quart Plastic Bag
PAHs, Phenols, Phthalates, Misc. Extractables, Chlorinated Organic Compounds	14 Days	125 g	4º±2ºC	2-8 oz Glass (combined)
Total Organic Carbon	14 Days	125 g	4º±2ºC	
Mercury	28 Days	5g	4º±2ºC	
Metals (except Mercury)	6 Months	50 g	4º±2ºC	
Pesticides and PCBs	14 Days	10 g	4º±2ºC	

a. Required samples sizes for one laboratory analysis. Actual volumes to be collected have been increased to provide a margin of error and allow for retest.
b. During transport to lab, samples will be stored on ice.

5. LABORATORY PHYSICAL AND CHEMICAL SEDIMENT ANALYSIS

5.1. Laboratory Analyses Protocols

Laboratory testing procedures shall be conducted in accordance with the DMEF. The samples shall be analyzed for all the parameters listed in sections 5.1.3 and 5.1.4 as requested on the chain-of-custody record. Columbia Analytical Services or their sub-contractors, private contract chemical analytical laboratories, shall conduct all physical and chemical analyses.

Three discrete samples will be collected and analyzed for PCBs. However, prior to analyses the 3 master samples will be split in the field. Procedure for splitting sample as follows: master sample will be mixed in clean stainless bowl, after mixing sample will be laid out on a clean surface and quartered. The 2 opposing quarters will be placed in one jar and the other 2 quarters in the jar to be archived (frozen) at the lab for possible future analyses. At the laboratory sample is to be analyzed it should be mixed and placed on a clean surface and a pie shaped segment selected for analysis. This assures that settling during shipment and storage does not affect segment analyzed.

5.1.1. Chain of Custody

A chain-of-custody record for each set of samples shall be maintained throughout all sampling activities and shall accompany samples and shipment to the laboratory. Information tracked by the chain-of-custody records in the laboratory includes sample identification number, date and time of sample receipt, analytical parameters required, location and conditions of storage, date and time of removal from and return to storage, signature of person removing and returning the sample, reason for removing from storage, and final disposition of the sample.

5.1.2. Limits of Detection

All reasonable means, including additional cleanup steps and method modifications, will be used to meet target levels. Detection of analytes between MRL and MDL should be "J" flagged and reported as an estimate. All analytes should meet detection levels listed in Table 7.2 of the SEF (See Appendix C).

5.1.3. Sediment Chemistry

Private analytical laboratories shall conduct all chemical analyses. Chemical analyses shall include: metals (6020 and 7471 series), total organic carbon (TOC) method 9060, polynuclear aromatic hydrocarbons (PAHs), phenols, phthalates, chlorinated organic compounds, miscellaneous extractables by 8270 SIM method or other low level detection method, pesticides 8081A and PCB's by 8082.

Table 4: Sediment Chemistry & Conventionals (See Section 5.1.3 & 5.1.4)

	Physical Suite	**Semi-Volatiles 8270C Low Level**	**Pest/PCBs 8081/8082**	***Metals 6010/6020 7471**	**TOC 9060**
060507BIFL-P-01	X	X	X	X	X
060507BIFL-P-02	X	X	X	X	X
060507BIFL-P-03	X	X	X	X	X
*Metals Sb, As, Cd, Cr, Cu, Pb, Hg, Ni, Ag, Zn					

5.1.4. Sediment Conventionals

The private analytical laboratories will analyze physical parameters. Particle grain size distribution for each sample shall be determined. Sieve analysis shall use a geological sieve series, which shall include the sieve sizes U.S. NO. 5, 10, 18, 35, 60, 120, and 230. Hydrogen peroxide shall not be used in preparations for grain-size analysis. Hydrometer analysis shall be run on particle sizes finer than the 230 mesh. Water content shall be determined using ASTM D 2216. Sediment classification designation shall be made in accordance with U.S. Soil Classification System, ASTM D 2487.

5.1.5. Holding Times

All samples for physical and chemical testing will be maintained at the testing laboratory at the temperatures specified in Table 3 and analyzed within the holding times shown in the table (unless archived). Samples will be retained by the lab for 60 days following analysis, except for the archived samples will be held for 1 year.

5.1.6. Quality Assurance/Quality Control

The chemistry QA/QC procedures found in Table 5 will be followed.

Table 5: Minimum Laboratory QA/QC

Analytical Type	Method Blank[2]	Duplicate[2]	RM[2,4]	Matrix Spikes[2]	Surrogates[7]
Semivolatiles[1]	X	X[3]	X[5]	X	X
Pesticides/PCBs[1]	X	X[3]	X[5]	X	X
Metals	X	X	X[6]	X	
Total Organic Carbon	X	X	X[6]		
Total Solids		X			
Total Volatile Solids		X			
Particle Size		X			

1. Initial calibration required before any samples are analyzed, after each major disruption of equipment, and when ongoing calibration fails to meet criteria. Ongoing calibration is required at the beginning of each work shift, every 10 – 12 samples or every 12 hours (whichever is more frequent), and at the end of each shift.
2. Frequency of Analysis is one per batch.
3. Matrix spike duplicate shall be run.
4. Reference material.
5. Canadian standard SRM-1.
6. NIST certified reference material 2704.
7. Surrogate spikes shall be included with every sample; including matrix-spiked samples, blanks, and reference materials.

The QC measures ICAL, ICV, CCV, blank, LCS, MS, MSD, surrogate spike analysis, and second column confirmation should be in accordance with the DOD QSM Version 3, dated January 2006. See tables B-2, B-6, B-7 for instrument maintenance and MS/MSD warning/control limits; D-3 for surrogates; D-7 for LCS limits for SVOC; D-15 for LCS limits for OC pesticides and D-17 for PCB aroclors.

6. BIOLOGICAL TESTING

6.1. Bioassays

Bioassays are not planned for this sampling event, unless further characterization is required. If a sufficient volume of *Corbicula fluminea* clams are recovered during the sampling event, tissue analysis may be analyzed.

7. REPORTING

7.1. QA Report

The laboratory QA/QC reports shall be incorporated by reference. This report shall identify any laboratory activities that deviated from the approved protocols and will make a statement regarding the overall validity of the data collected.

7.2. Sediment Evaluation Report

A written discussion of findings shall be prepared documenting the physical, chemical and biological (if necessary) character of potential material to be dredged. The physical and chemical reports shall be included as reference; individual copies will be furnished as requested. As a minimum, the following shall be included in the

- Previous sampling and analyses.
- Locations where the sediment samples were collected.
- A plan view of the project showing the actual sampling location.
- Description of sampling.
- Chemical testing data, with comparisons to screening levels guidelines
- Evaluate risk using the Conceptual Site Model as described in the SEF (see Figure 1).

Fish and benthos are likely to have a complete pathway (represented by a circle). Benthos would likely be in extended contact (represented by a filled circle). However due to the location salmon and resident fish do not linger in the area and therefore have a potential, but likely not a significant exposure (represented by the open circle). The other potential receptors have an incomplete or insignificant pathway and are represented by a dash.

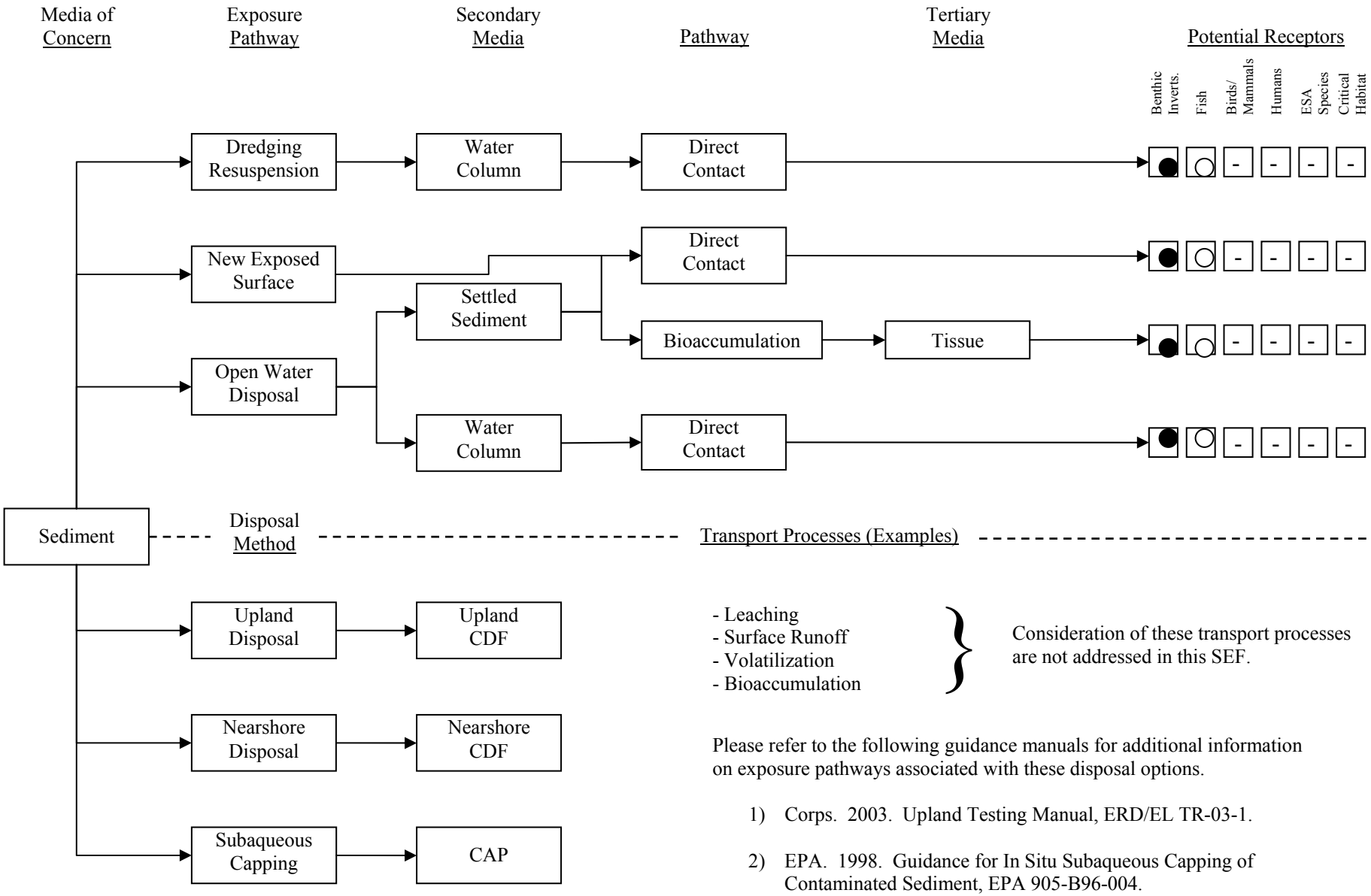
Only benthos and fish (including threatened and endangered species) are likely to have a complete pathway. Benthos are likely to be in extended contact with the sediment, but salmonids and resident fish do not linger in this area.

"●" – complete pathway

"○" – potentially complete pathway, but likely insignificant

" – " - incomplete or insignificant pathway

Figure 1: Dredging Conceptual Site Model.



- Leaching
- Surface Runoff
- Volatilization
- Bioaccumulation

Consideration of these transport processes are not addressed in this SEF.

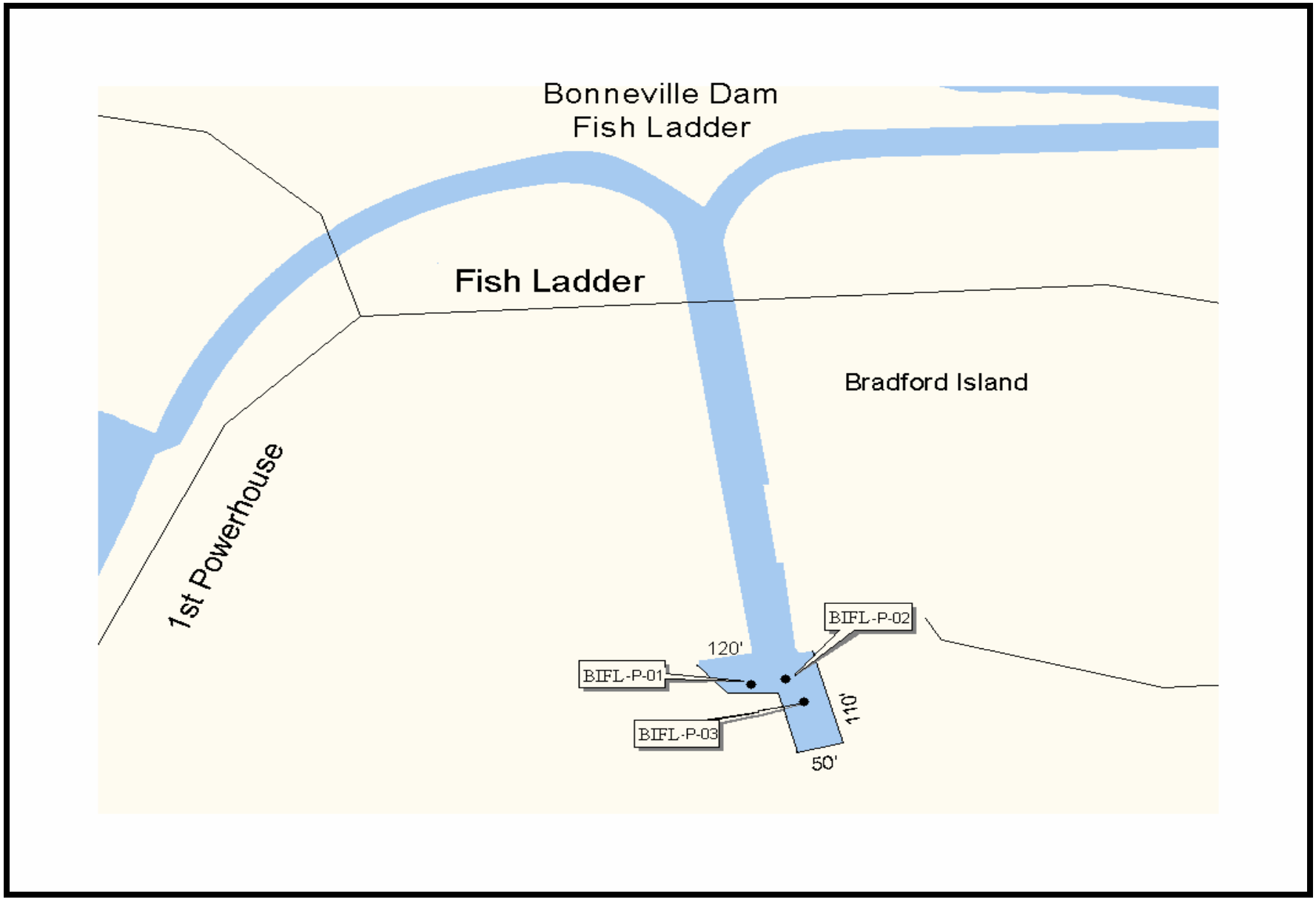
Please refer to the following guidance manuals for additional information on exposure pathways associated with these disposal options.

1) Corps. 2003. Upland Testing Manual, ERD/EL TR-03-1.

2) EPA. 1998. Guidance for In Situ Subaqueous Capping of Contaminated Sediment, EPA 905-B96-004.

Figure 2: Vicinity Map of Bonneville Dam (Fish Ladder)

Figure 3: Proposed Sampling Station Locations



APPENDIX A: PARAMETERS AND METHODS

1. Recommended Sample Preparation Methods, Cleanup Methods, Analytical Methods and Detection Limits for Sediment Management Standards, Chapter 173-204 WAC, Draft - July 1996.

2. Recommended Protocols for Measuring Conventional Sediment Variables in Puget Sound, Puget Sound Estuary Program, March 1986.

3. Recommended Methods for Measuring TOC in Sediments, Kathryn Bragdon-Cook, Clarification Paper, Puget Sound Dredged Disposal Analysis Annual Review, May, 1993.

4. Units: ug = microgram, mg = milligram, kg = kilogram, dw = dry weight, oc = organic carbon.

5. Test Methods for Evaluating Solid Waste. Laboratory manual physical/chemical methods. Method 3050, SW-846, 3rd ed., Vol. 1A, Chapter 3, Sec 3.2, Rev 1. Office of Solid Waste and Emergency Response, Washington, DC.

6. Graphite Furnace Atomic Absorption (GFAA) Spectrometry - SW-846, Test Methods for Evaluating Solid Waste Physical/Chemical Methods, EPA 1986.

7. Inductively Coupled Plasma (ICP) Emission Spectrometry - SW-846, Test Methods for Evaluating Solid Waste Physical/Chemical Methods, EPA 1986.

8. Test Methods for Evaluating Solid Waste. Laboratory manual physical/chemical methods. Method 7471, SW-846, 3rd ed., Vol. 1A, Chapter 3, Sec 3.3. Office of Solid Waste and Emergency Response, Washington, DC.

9. Sonication Extraction of Sample Solids - Method 3550 (Modified), SW-846, Test Methods for Evaluating Solid Waste Physical/Chemical Methods, EPA 1986. Method is modified to add matrix spikes before the dehydration step rather than after the dehydration step.

10. GCMS Capillary Column - Method 8270, SW-846, Test Methods for Evaluating Solid Waste Physical/Chemical Methods, EPA 1986.

11. Purge and Trap Extraction and GCMS Analysis - Method 8260, Test Methods for Evaluating Solid Waste Physical/Chemical Methods, EPA 1986.

12. Soxlet Extraction and Method 8081, Test Methods for Evaluating Solid Waste Physical/Chemical Methods, EPA 1986.

13. Total PCBs BT value in ug/kg oc.

APPENDIX B: QA2 DATA REQUIREMENTS
CHEMICAL VARIABLES

ORGANIC COMPOUNDS

The following documentation is needed for organic compounds:

a. A cover letter referencing or describing the procedure used and discussing any analytical problems.

b. Reconstructed ion chromatograms for GC/MS analyses for each sample.

c. Mass spectra of detected target compounds (GC/MS) for each sample and associated library spectra.

d. GC/ECD and/or GC/flame ionization detection chromatograms for each sample.

e. Raw data quantification reports for each sample.

f. A calibration data summary reporting calibration range used [and decafluorotriphenylphosphine (DFTPP) and bromofluorobenzene (BFB) spectra and quantification report for GC/MS analyses].

g. Final dilution volumes, sample size, wet-to-dry ratios, and instrument detection limit.

h. Analyte concentrations with reporting units identified (to two significant figures unless otherwise justified).

i. Quantification of all analytes in method blanks (ng/sample).

j. Method blanks associated with each sample.

k. Recovery assessments and a replicate sample summary (laboratories should report all surrogate spike recovery data for each sample; a statement of the range of recoveries should be included in reports using these data).

l. Data qualification codes and their definitions.

METALS

For metals, the data report package for analyses of each sample should include the following:

a. Tabulated results in units as specified for each matrix in the analytical protocols, validated and signed in original by the laboratory manager.

b. Any data qualifications and explanation for any variance from the analytical protocols.

c. Results for all of the QA/QC checks initiated by the laboratory.

d. Tabulation of instrument and method detection limits.

e. All contract laboratories are required to submit metals results that are supported by sufficient backup data and quality assurance results to enable independent QA reviewers to conclusively determine the quality of the data. The laboratories should be able to supply legible photocopies of original data sheets with sufficient information to unequivocally identify:

f. Calibration results.

g. Calibration and preparation blanks.

h. Samples and dilutions.

i. Duplicates and spikes.

j. Any anomalies in instrument performance or unusual instrumental adjustment.

APPENDIX C:

RECOMMENDED ANALYTICAL AND QUANTITATION LIMITS

Recommended Analytical Methods and Quantitation Limits for Sediment			
Parameter	**Prep Method**	**Analysis Method**	**Sample Quantitation Limit (SQL) [1/]**
Conventionals:			
Total Solids (%)		EPA 2450-G	0.1
Total Organic Carbon (%)		EPA 5310B mod	0.1
Total Sulfides (mg/kg)		PSEP 1997	1.0
Ammonia (mg/kg)		Plumb 1981	0.1
Grain Size (%)		ASTM D-422 mod	1.0
Metals (mg/kg):			
Antimony	EPA 6010/6020 [2/]	EPA 6010/6020	0.5
Arsenic	EPA 6010/6020	EPA 6010/6020	5
Cadmium	EPA 6010/6020	EPA 6010/6020	0.5
Chromium	EPA 6010/6020	EPA 6010/6020	0.5
Copper	EPA 6010/6020	EPA 6010/6020	5
Lead	EPA 6010/6020	EPA 6010/6020	0.1
Mercury	EPA 7471	EPA 7471	0.05
Nickel	EPA 6010/6020	EPA 6010/6020	5
Silver	EPA 6010/6020	EPA 6010/6020	0.5
Zinc	EPA 6010/6020	EPA 6010/6020	5
Polynuclear Aromatic Hydrocarbons (µg/kg):			
LPAH			
Naphthalene	EPA 3550-mod	EPA 8270	6.7
Acenaphthylene	EPA 3550-mod	EPA 8270	6.7
Acenaphthene	EPA 3550-mod	EPA 8270	6.7
Fluorene	EPA 3550-mod	EPA 8270	6.7
Phenanthrene	EPA 3550-mod	EPA 8270	6.7
Anthracene	EPA 3550-mod	EPA 8270	6.7
2-Methylnaphthalene	EPA 3550-mod	EPA 8270	6.7
HPAH			
Fluoranthene	EPA 3550-mod	EPA 8270	6.7
Pyrene	EPA 3550-mod	EPA 8270	6.7
Benzo(a)anthracene	EPA 3550-mod	EPA 8270	6.7
Chrysene	EPA 3550-mod	EPA 8270	6.7
Benzofluoranthenes	EPA 3550-mod	EPA 8270	6.7

Recommended Analytical Methods and Quantitation Limits for Sediment			
Parameter	**Prep Method**	**Analysis Method**	**Sample Quantitation Limit (SQL) [1/]**
Benzo(a)pyrene	EPA 3550-mod	EPA 8270	6.7
Indeno(1,2,3-c,d)pyrene	EPA 3550-mod	EPA 8270	6.7
Dibenzo(a,h)anthracene	EPA 3550-mod	EPA 8270	6.7
Benzo(g,h,i)perylene	EPA 3550-mod	EPA 8270	6.7
Chlorinated Hydrocarbons (µg/kg):			
1,4-Dichlorobenzene	EPA 3550-mod	EPA 8270	20
1,2-Dichlorobenzene	EPA 3550-mod	EPA 8270	20
1,2,4-Trichlorobenzene	EPA 3550-mod	EPA 8270	20
Hexachlorobenzene (HCB)	EPA 3550/3540	EPA 8270/8081	10
Phthalates (µg/kg):			
Dimethyl phthalate	EPA 3550-mod	EPA 8270	1.0
Diethyl phthalate	EPA 3550-mod	EPA 8270	1.0
Di-n-butyl phthalate	EPA 3550-mod	EPA 8270	1.0
Butyl benzyl phthalate	EPA 3550-mod	EPA 8270	1.0
Bis(2-ethylhexyl)phthalate	EPA 3550-mod	EPA 8270	1.0
Di-n-octyl phthalate	EPA 3550-mod	EPA 8270	1.0
Phenols (µg/kg):			
Phenol	EPA 3550-mod	EPA 8270	20
2 Methylphenol	EPA 3550-mod	EPA 8270	20
4 Methylphenol	EPA 3550-mod	EPA 8270	20
2,4-Dimethylphenol	EPA 3550-mod	EPA 8270	20
Pentachlorophenol	EPA 3550-mod	EPA 8270	100
Miscellaneous Extractables (µg/kg):			
Benzyl alcohol	EPA 3550-mod	EPA 8270	50
Benzoic acid	EPA 3550-mod	EPA 8270	100
Dibenzofuran	EPA 3550-mod	EPA 8270	20
Hexachloroethane	EPA 3550-mod	EPA 8270	20
Hexachlorobutadiene	EPA 3550/3540	EPA 8270/8081	10
N-Nitrosodiphenylamine	EPA 3550-mod	EPA 8270	20
Pesticides/PCBs (µg/kg):			
DDE (p,p'-, o,p'-)	EPA 3540	EPA 8081	2
DDD (p,p'-, o,p'-)	EPA 3540	EPA 8081	2
DDT (p,p'-, o,p'-)	EPA 3540	EPA 8081	2
Aldrin	EPA 3540	EPA 8081	2
Chlordane	EPA 3540	EPA 8081	2
Dieldrin	EPA 3540	EPA 8081	2
Heptachlor	EPA 3540	EPA 8081	2

Recommended Analytical Methods and Quantitation Limits for Sediment

Parameter	Prep Method	Analysis Method	Sample Quantitation Limit (SQL) [1/]
Lindane	EPA 3540	EPA 8081	2
Total PCBs	EPA 3540	EPA 8082	0.5

Notes:
1/ SQLs are based on dry sample weight assuming no interferences; site-specific method modifications may be required to achieve these SQLs in some cases.
2/ Includes hydrochloric acid digestion per EPA 3050-B.

ATTACHMENT B

Bonneville Bradford Island Fish Ladder Sediment Quality Evaluation Report

July 2011

US Army Corps
of Engineers®
Portland District

BONNEVILLE
BRADFORD ISLAND FISH LADDER
SEDIMENT QUALITY EVALUATION
REPORT

Sampled July 2007

Prepared by:
Wendy Briner

Technical Review
Mark Siipola

Portland District
Corps of Engineers
CENWP-EC-HR

US Army Corps of Engineers®
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ACRONYMS

EPA	Environmental Protection Agency
USACE	U.S. Army Corps of Engineers
NMFS	National Marine Fisheries Service (NOAA Fisheries)
USF&W	US Fish and Wildlife
WDOE	Washington Department of Ecology
ODEQ	Oregon Department of Environmental Quality
WDNR	Washington Department of Natural Resources
DMEF	Dredge Material Evaluation Framework
SEF	Sediment Evaluation Framework (2006 Updated DMEF)
NES	Newly Exposed Surface
QA/QC	Quality Assurance/Quality Control
TEL	Threshold Effects Level
TOC	Total Organic Carbon
PAH	Polynuclear Aromatic Hydrocarbon
PCB	Polychlorinated Biphenyl
MDL	Method Detection Limit
PQL	Practical Quantitation Limit
MRL	Method Reporting Limit
TVS	Total Volatile Solids
TEF	Toxicity Equivalent Factor
TEQ	Toxicity Equivalent Quotient
ND	non-detect
ppm	parts per million – mg/kg
ppb	parts per billion – ug/kg or ug/L
pptr	parts per trillion – ng/kg
SL	Screening level
As	Arsenic
Cd	Cadmium
Ni	Nickel
Cu	Copper
Sb	Thallium
Cr	Chromium
Pb	Lead
Hg	Mercury
Ni	Nickel
Ag	Silver
Zn	Zinc
GC	Gas Chromatography

US Army Corps of Engineers®
Portland District

Table of Contents

Bradford Island Fish Ladder
SEDIMENT QUALITY EVALUATION
Sampled July 31, 2007

ABSTRACT

Bonneville Dam is located between River Mile (RM) 145 and 146 of the Columbia River. The proposed dredge site is located at the fish exit (water entrance) of the fish ladder east of the Bonneville Dam First Powerhouse on the south side of Bradford Island. Approximately 2000 CY or less will be dredged by clam shell. As a management option material will be placed at an approved upland disposal site.

The 2007 physical analyses resulted in mean values of 5.8% gravel (0.4% to 12.8% range), 36.3% sand (23.2% to 28.8% range), and 51.9% silt/clay (15.9% to 71.8% range), with 5.20% volatile solids (4.63% to 5.74% range).

The chemical analyses (see Tables 3-5) indicates only very low levels of contamination in any of the samples, with all levels below their respective SEF screening levels (SLs), with the exception of mercury (Hg), which averaged 0.362 mg/kg (ppm) (range 0.319 ppm to 0.402 ppm), exceeding the SEF screening level of 0.280 ppm. The analytical results of this characterization are consistent with historical data, again with the exception of mercury levels, which in the 2001 sampling event for dredging at the fish ladder contained an average of 0.209 ppm (range 0.202 ppm to 0.220 ppm) mercury. In a 2002 study conducted in the Bonneville Dam forebay, the average level of mercury detected in samples analyzed from 8 stations was 0.109 ppm (range 0.05 ppm to 0.188 ppm). Detection levels were sufficiently low enough to evaluate material proposed for dredging.

The management plan for the approximately 2000 CYs of material at the fish ladder calls for the material to be placed upland at a licensed landfill, therefore the level of mercury (0.352 mg/kg) in the dredge prism, even though it exceeds the SEF screening level (0.28 mg/kg), is not an in-water disposal issue. Because this is a frequently dredged area, which has not had elevated mercury levels above the 0.28 mg/kg screening level (0.21 mg/kg in 2001 Fish Ladder Study and 0.10 mg/kg in 2003 Forebay Study) dredging down to the previously exposed surface will leave an acceptable level in the NSM.

INTRODUCTION

The sampling and analysis objectives are stated in the Sampling and Analysis Plan and are, also, listed below. This report will characterize the sediment to be dredged and outline the procedures used to accomplish these objectives.

Sampling and Analysis Objectives

- Characterize sediments in accordance with the regional dredge material testing manual protocols:
    - Sediment Evaluation Framework (SEF), 2006.

- Collect, handle and analyze representative sediment from Bradford Island Fish ladder exit (water entrance) in accordance with protocols and Quality Assurance/Quality Control (QA/QC) requirements.

- Characterize sediments to be dredged for evaluation of suitability of in-water disposal (management plan calls for material to be place upland).

- Analyze for full suite of physical and chemical parameters as outlined in the SEF (2006). SEF – Table 7.2 (Appendix C of this report) contains the list of analytes and methods of analysis. Organotin will not be considered an in-water contaminate of concern at the fish ladder; results from the 2001 sediment sampling event indicate it is not present above detection limits.

PREVIOUS STUDIES

In 1991 informational sampling and analysis was done on sediment downstream from the First Powerhouse Navigational Lock, on the south side of the river, with results acceptable for unconfined in-water or upland disposal. This same downstream area was dredged in1986 and in the late 1970s.

In July 1997 seven sediment samples were collected from Bonneville Second Powerhouse forebay and water supply conduits. Two of the samples were taken from the downstream portion of the south Auxiliary Water Supply (AWS) conduit by divers inspecting the inside of the south AWS. Three additional samples were taken from the surface of the sediment deposits at the north end of the forebay. The final two samples were collected from the sediment and woody debris removed from the north AWS intake trash rack by clamshell and stockpiled on Cascade Island, at the south end of the Elevation 90 Deck crane way extension. Physical analysis, run on four sediments, indicated the material ranges from gavel to very fine sand, with largest fractions in the coarse to medium sand range. Chemical analysis, run on five sediments, included metals, pesticides/polychlorobiphenyls (PCBs), polynuclear aromatic hydrocarbons (PAHs), total organic carbon (TOC), acid volatile sulfide (AVS), phenols and dioxin screen (P450). The portion of the sample submitted to the lab was representative of the material dredged, except for the woody debris. Results determined the material to be acceptable for unconfined in-water or upland disposal.

Beginning in May 2001 sediment samples were taken from an area at the Northeast end of Bradford Island, which contained high levels of PCBs from discarded electrical components discovered in the near shore area. Since the initial sampling event, several rounds of samples have been collected, both from in-water and upland areas. All discarded electrical components have been removed from the water. The investigation of this former dumpsite is still in progress. Currently a sampling plan has been developed to further analyze sediments and both benthic and aquatic organisms.

In December 2001 three (3) sediment samples were collected from the fish ladder exit. The samples were collected using a ponar sampling device (a gravity core sampler was tried, but had only about 12” penetration). All samples were submitted for physical analyses including total volatile solids (TVS) and were analyzed for metals (9 inorganic), total organic carbon (TOC), pesticides and

polychlorinated biphenyls (PCBs), phenols, phthalates, miscellaneous extractables, polynuclear aromatic hydrocarbons (PAHs) and organotin (TBT).

None of the laboratory data results exceeded their respective screening levels in the DMEF. Levels of DDT and its derivatives (DDD & DDE) were found in all three of the samples at levels ranging from 6.39 to 6.78 ug/kg (ppb), but did not exceed the 6.9 ug/kg DMEF screening level. All sediment is determined to be suitable for unconfined, in-water placement or suitable upland placement with return water without further characterization under guideline of the DMEF.

Although the 1,577 CY of material dredged was determined to be suitable for unconfined in-water placement, it was determined, as a management option, to barge the material to RABANCO Regional Disposal Company's facility in Roosevelt Washington.

In September 2002, 8 sediment samples were collected during the Bonneville Forebay and Upstream Locations sediment evaluation. This evaluation did not include sampling the Bradford Island remediation site. Fifty-five (55) sampling attempts were made at twenty-seven (27) sampling stations, but only 8 samples collected due to the rocky nature of the river bottom and the current effect in much of the area. Two samples were collected from the forebay area, and six samples were collected above the eddy effect area. and analyzed for DMEF contaminates of concern. Mean grain-size for all the samples is 0.91 mm, with 8.2% gravel, 65.3% sand and 26.4% fines. Volatile solids for all the samples ranged from 2210 mg/kg to 47000 mg/kg. No metals, PCBs, PAHs, phthalates, or miscellaneous extractables were detected above DMEF screening levels. One sample, BF-BC-A, had a phenol concentration of 71.5 ppb, above the DMEF SL of 28 ppb. Sample BF-BC-A was a blind duplicate of BF-BC-03 and a Quality Assurance laboratory split for BF-BC-AQA. Neither parent sample contained an elevated phenol concentration.

The report concluded that little sediment is deposited on the north side of the Columbia River in the forebay area or in the upstream area where sampling was attempted. Sediment was not available downstream of he rocky island east of Bradford Island. This sampling even did not confirm detectable PCBs in the Goose Island sediment. It was also concluded that PCB contamination is not widespread in the forebay area or upstream and that PCB contamination has not migrated beyond the localized area of Bradford Island.

CURRENT SAMPLING EVENT/DISCUSSION

Three ponar grab samples were collected from the river adjacent to the Bradford Island Fish Ladder on July 31, 2007. All samples were submitted for physical analyses including total volatile solids and were, also, analyzed for metals (9 inorganic), total organic carbon, pesticides and polychlorinated biphenyls, phenols, phthalates, miscellaneous extractables, and polynuclear aromatic hydrocarbon.

The 2007 physical analyses resulted in mean values of 5.8% gravel (0.4% to 12.8% range), 36.3% sand (23.2% to 28.8% range), and 51.9% silt/clay (15.9% to 71.8% range), with 5.20% volatile solids (4.63% to 5.74% range).

The chemical analyses (see Tables 3-5) indicates only very low levels of contamination in any of the samples, with all levels below their respective SEF screening levels (SLs), with the exception of

mercury (Hg), which averaged 0.362 mg/kg (ppm) (range 0.319 ppm to 0.402 ppm), exceeding the SEF screening level of 0.280 ppm. The analytical results of this characterization are consistent with historical data, again with the exception of mercury levels, which in the 2001 sampling event for dredging at the fish ladder contained an average of 0.209 ppm (range 0.202 ppm to 0.220 ppm) mercury. In a 2002 study conducted in the Bonneville Dam forebay, the average level of mercury detected in samples analyzed from 8 stations was 0.109 ppm (range 0.05 ppm to 0.188 ppm). Detection levels were sufficiently low enough to evaluate material proposed for dredging.

Because concentrations of mercury were found to be above freshwater screening levels in all three samples, the sediments represented by all samples in this sampling event are determined NOT to be suitable for unconfined, in-water placement without further characterization. However, the material is planned to be placed upland at a licensed landfill.

Table 1, Sample Location Coordinates, (NAD 83, Oregon State Plane North)

Sample Id	Latitude	Longitude
073107BIFL-P-01	45º 38.462’	121º 56.572’
073107BIFL-P-02	45º 38.460’	121º 56.539’
073107BIFL-P-03	45º 38.430’	121º 56.528’

RESULTS

Physical and Volatile Solids (ASTM methods)

The 2007 physical analyses resulted in mean values of 5.8% gravel (0.4% to 12.8% range), 36.3% sand (23.2% to 28.8% range), and 51.9% silt/clay (15.9% to 71.8% range), with 5.20% volatile solids (4.63% to 5.74% range).

Metals (EPA method 6020/7471), Total Organic Carbon (EPA method 9060)

All 2007 sediment samples were submitted for testing, with data presented in Table 3. The TOC ranged from 1.52 to 1.74%.

Low levels of As, Cd, Cu, Pb, Hg, Ni, Ag and Zn were detected in all samples, but no levels approach their respective SEF SL, with the exception of mercury (Hg), which averaged 0.362 mg/kg (ppm) (range 0.319 ppm to 0.402 ppm), exceeding the SEF screening level of 0.280 ppm. The analytical results of this characterization are consistent with historical data, again with the exception of mercury

levels, which in the 2001 sampling event for dredging at the fish ladder contained an average of 0.209 ppm (range 0.202 ppm to 0.220 ppm) mercury. In a 2002 study conducted in the Bonneville Dam forebay, the average level of mercury detected in samples analyzed from 8 stations was 0.109 ppm (range 0.05 ppm to 0.188 ppm).

Pesticides/PCBs (EPA method 8081A/8082), Phenols, Phthalates, Miscellaneous Extractables (EPA method 8270)

All 2007 sediment samples were submitted for testing, with data presented in Table 4. No PCBs or chlorinated hydrocarbons were detected in the samples. Few phenols, phthalates, pesticides, and miscellaneous extractables were found at low levels in some of the samples. MDLs/MRLs were sufficiently below screening levels for good evaluation of material tested.

Polynuclear Aromatic Hydrocarbons (EPA method 8270C)

All 2007 sediment samples were submitted for testing, with data presented in Table 5. Very low levels of "low molecular weight" and "high molecular weight" PAHs were detected, with detected levels well below screening levels of the SEF. MDLs/MRLs were sufficiently below screening levels for good evaluation of material tested.

CONCLUSION

Collection and evaluation of the sediment data was completed using guidelines from the 2006 Interim Final SEF. The SEF (updated version of the DMEF) is a regional manual developed jointly with regional EPA, Corps, NMFS, USF&W, Oregon Department of Environmental Quality and Washington Departments of Ecology and Natural Resources. This document is guidance for implementing the Clean Water Act (40 CFR 230), Section 404 (b)(1). The DMEF/SEF use a tiered testing approach that requires material in excess of 20% fines and greater than 5% volatile solids, as well as any material with prior history or is suspected ("reason to believe") of being contaminated, be subjected to chemical as well as physical analyses.

Three ponar grab samples were collected from the river adjacent to the Bradford Island Fish Ladder on July 31, 2007. All samples were submitted for physical analyses including total volatile solids and were, also, analyzed for metals (9 inorganic), total organic carbon, pesticides and polychlorinated biphenyls, phenols, phthalates, miscellaneous extractables, and polynuclear aromatic hydrocarbon.

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historical data, again with the exception of mercury levels, which in the 2001 sampling event for dredging at the fish ladder contained an average of 0.209 ppm (range 0.202 ppm to 0.220 ppm) mercury. In a 2002 study conducted in the Bonneville Dam forebay, the average level of mercury detected in samples analyzed from 8 stations was 0.109 ppm (range 0.05 ppm to 0.188 ppm). Detection levels were sufficiently low enough to evaluate material proposed for dredging.

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REFERENCES

1. U.S. Army Corps of Engineers, Portland District and Seattle District; U.S. Environmental Protection Agency, Region 10; Oregon Department of Environmental Quality; Washington State Department of Natural Resources and Department of Ecology; National Marine Fisheries Service; US Fish and Wildlife. 2006 Interim Final. Sediment Evaluation Framework.

2. U.S. Environmental Protection Agency and U.S. Army Corps of Engineers. February 1998. Evaluation of Dredged Material Proposed for Discharge in Inland and Near Coastal Waters - Testing Manual (referred to as the "Inland Testing Manual").

3. U.S. Army Corps of Engineers. January 2003. Evaluation of Dredged Material Proposed for Disposal at Island, Nearshore, or Upland Confined Disposal Facilities - Testing Manual (referred to as the "Upland Testing Manual").

4. Clean Water Act, 40 CFR 230 (b)(1).

5. PSDDA. 1996. Puget Sound Dredged Disposal Analysis, Technical Information Memorandum, Testing, Reporting and Evaluation of Dioxin/furan Data in PSDDA Programs.

6. Briton J. U.S. Army Corps of Engineers, Portland District. September 1991. Bonneville Navigation Lock Sediment Evaluation.

7. U. S. Army Corps of Engineers, Portland District. October 1991. Columbia River Pool Lowering (MOP).

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9. Cornforth Consultants Inc. U.S. Army Corps of Engineers, Portland District. May & November 2001. Bonneville Second Powerhouse Corner Collector Bypass System.

10. URS Consultants Inc., for U.S. Army Corps of Engineers, Portland District. September 2001. Bradford Island Landfill Cascade Locks, Oregon. URS Portland Oregon.

11. U.S. Army Corps of Engineers. 2001. Sediment Sampling and Analysis Plan for Bonneville Dam, Bradford Island Fish Ladder. Portland District.

Table 3: Physical Analysis and Volatile Solids

Sample I.D.	Grain Size Percent (%)				
	Gravel	**Sand**	**Silt/Clay**	**Volatile Solids**	**TOC**
073107BFL-P-01	12.8	58.5	15.9	4.63	1.67
073107BFL-P-02	0.4	27.4	71.8	5.74	1.87
073107BFL-P-03	4.3	23.2	68.2	5.22	1.52
Average	5.83	36.36	51.96	5.20	1.69
Minimum	0.4	23.2	15.9	4.63	1.52
Maximum	12.8	58.8	71.8	5.74	1.87
BFL = Bonneville Fish Ladder P = Ponar (surface grab sampler)					

Table 4: Inorganic Metals - EPA method 6020/7471A (mg/kg)

Sample I.D.	As	Cd	Cr	Sb	Cu	Pb	Ni	Ag	Zn	Hg
073107BFL-P-01	2.52	0.59	9.47	0.20	15.7	11.3	11.6	0.065	110	**0.334***
073107BFL-P-02	2.64	0.559	10.6	0.17	20.1	9.42	12.6	0.072	86.3	**0.319***
073107BFL-P-03	2.56	0.618	12.1	0.18	25.3	11.0	13.1	0.077	91.7	**0.402***
SEF (SL)	20	1.1	95	--	80	340	60	2.0	130	0.28

* Mercury levels in material dredged in 2001 averaged 0.21ppm & 0.10 ppm average in samples collected in forebay in 2003.
Symbol (<) = Non-detect (ND) at the value listed (Method Reporting Limit).
Symbol (--) = Screening Level not established.

Table 5: Polychlorinated Biphenyl (PCBs) - EPA Method 8082 (ug/kg)

Sample I.D.	PCB Aroclors							
	1016	**1221**	**1232**	**1242**	**1248**	**1254**	**1260**	**Sum ∑**
073107BFL-P-01	<7.6	<16	<7.6	<7.6	<7.6	<7.6	<7.6	ND
073107BFL-P-02	<9.5	<19	<9.5	<9.5	<9.5	<9.5	<9.5	ND
073107BFL-P-03	<9.8	<20	<9.8	<9.8	<9.8	<9.8	<9.8	ND
SEF (SL)							Total	60

Sediment Evaluation Framework (2006 Interim Final Fresh water S1 value)
Symbol (<) = Non-detect (ND) at the value listed (Method Reporting Limit).

Table 6: Pesticides - EPA Method 8081 (ug/kg)

Sample I.D.	Aldrin	Chlordane	Dieldrin	Heptachlor	Gamma-BHC (Lindane)	4,4'-DDD	4,4'-DDE	4,4'-DDT	Sum ∑ DDT
073107BFL-P-01	<1.0	<10	<1.0	**0.33JP**	<1.0Ui	<1.0Ui	**0.93J**	<1.0Ui	**0.93J**
073107BFL-P-02	<1.0	<10	<1.0	**0.17**	<1.0	<1.0Ui	<1.0Ui	<1.0	ND
073107BFL-P-03	<1.0	<10	<1.0	**0.44JP**	<1.0Ui	**1.2P**	**1.4**	<1.0Ui	**2.6**
SEF (SL)	--	--	--	--	--	--	--	--	--

J=The result is an estimated concentration that is less than the MRL but greater than or equal to the MDL.
i =The MRL/MDL has been elevated due to matrix interference.
P=The GC or HPLC confirmation criteria was exceeded.
Symbol (<) = Non-detect (ND) at the value listed (Method Reporting Limit).
Symbol (--) = Screening Level not established.

Table 7: Chlorinated Hydrocarbons - EPA Method 8270 (ug/kg)

Sample I.D.	1,3-Dichlorobenzene	1,4-Dichlorobenzene	1,2-Dichlorobenzene	1,2,4-Trichlorobenzene	Hexachlorobenzene
073107BFL-P-01	<9.8	<9.8	<9.8	<9.8	<9.8
073107BFL-P-02	<9.9	<9.9	<9.9	<9.9	<9.9
073107BFL-P-03	<9.9	<9.9	<9.9	<9.9	<9.9
SEF (SL)	--	--	--	--	--

Symbol (<) = Non-detect (ND) at the value listed (Method Reporting Limit).
Symbol (--) = Screening Level not established.

Table 8: Miscellaneous Extractables - EPA Method 8270C (ug/kg)

Sample I.D.	Benzyl alcohol	Benzoic Acid	Dibenzofuran	Hexachloroethane	Hexachloro-butadiene	N-Nitroso diphenylamine
073107BFL-P-01	**7.6J**	<200	<9.8	<9.8	<9.8	<9.8
073107BFL-P-02	<20	<210	<9.9	<9.9	<9.9	<9.9
073107BFL-P-03	<20	**240**	<9.9	<9.9	<9.9	<9.9
SEF (SL)	--	-- (650*)	400	--	--	--

Symbol (--) = Screening Level not established in SEF.
Symbol (<) = Non-detect (ND) at the value listed (Method Reporting Limit).
*SEF Marine SL1 & DMEF SL

Table 9: Phthalates - EPA Method 8270C (ug/kg)

Sample I.D.	Dimethyl phthalate	Diethyl phthalate	Di-n-butyl phthalate	Butyl benzyl phthalate	Bis (2-ethylhexyl) phthalate	Di-n-octyl phthalate
073107BFL-P-01	<9.8	<9.8	**29B**	<9.8	<98	<9.8
073107BFL-P-02	<9.9	<9.9	**35B**	<9.9	<99	<9.9
073107BFL-P-03	**2.4J**	<9.9	**28B**	<9.9	<99	<9.9
SEF (SL)	46	--	--	260	220	26

Symbol (--) = Screening Level not established in SEF.
Symbol (<) = Non-detect (ND) at the value listed (Method Reporting Limit).
J = Estimated value (reported values are above the MDL, but below the MRL).
B=The analyte was found in the associated method blank at a level that is significant relative to the sample result.

Table 10: Phenols - EPA Method 8270C (ug/kg)

Sample I.D.	Phenol	2-Methyl phenol	4-Methyl phenol	2,4-Dimethyl phenol	Pentachloro phenol
073107BFL-P-01	**64**	<9.8	**79**	<49	<98
073107BFL-P-02	<30	<9.9	**79**	<50	<99
073107BFL-P-03	**57**	<9.9	**320**	<50	<99
SEF (SL)	--*(420)	--	--* (670)	--	--

*SEF Marine SL1 & DMEF SL
Symbol (<) = Non-detect (ND) at the value listed (Method Reporting Limit).
Symbol (--) = Screening Level not established in SEF.

Table 11: Polynuclear Aromatic Hydrocarbons (PAHs) Low Molecular Weight - EPA Method 8270C (ug/kg)

Sample I.D.	Acenaphthene	Acenaphthylene	Anthracene	Fluorene	2-Methyl naphthalene	Naphthalene	Phen-anthrene	Total Low PAHs
073107BFL-P-01	<9.8	<9.8	<9.8	<9.8	<9.8	<9.8	**10**	10
073107BFL-P-02	<9.9	<9.9	<9.9	<9.9	<9.9	<9.9	<9.9	ND
073107BFL-P-03	<9.9	<9.9	<9.9	<9.9	<9.9	<9.9	**3.4J**	**3.4J**
SEF (SL)	1100	470	1200	1000	470	500	6100	6600

Symbol (<) = Non-detect (ND) at the value listed (Method Reporting Limit).
J=The result is an estimated concentration that is less than the MRL but greater than or equal to the MDL.

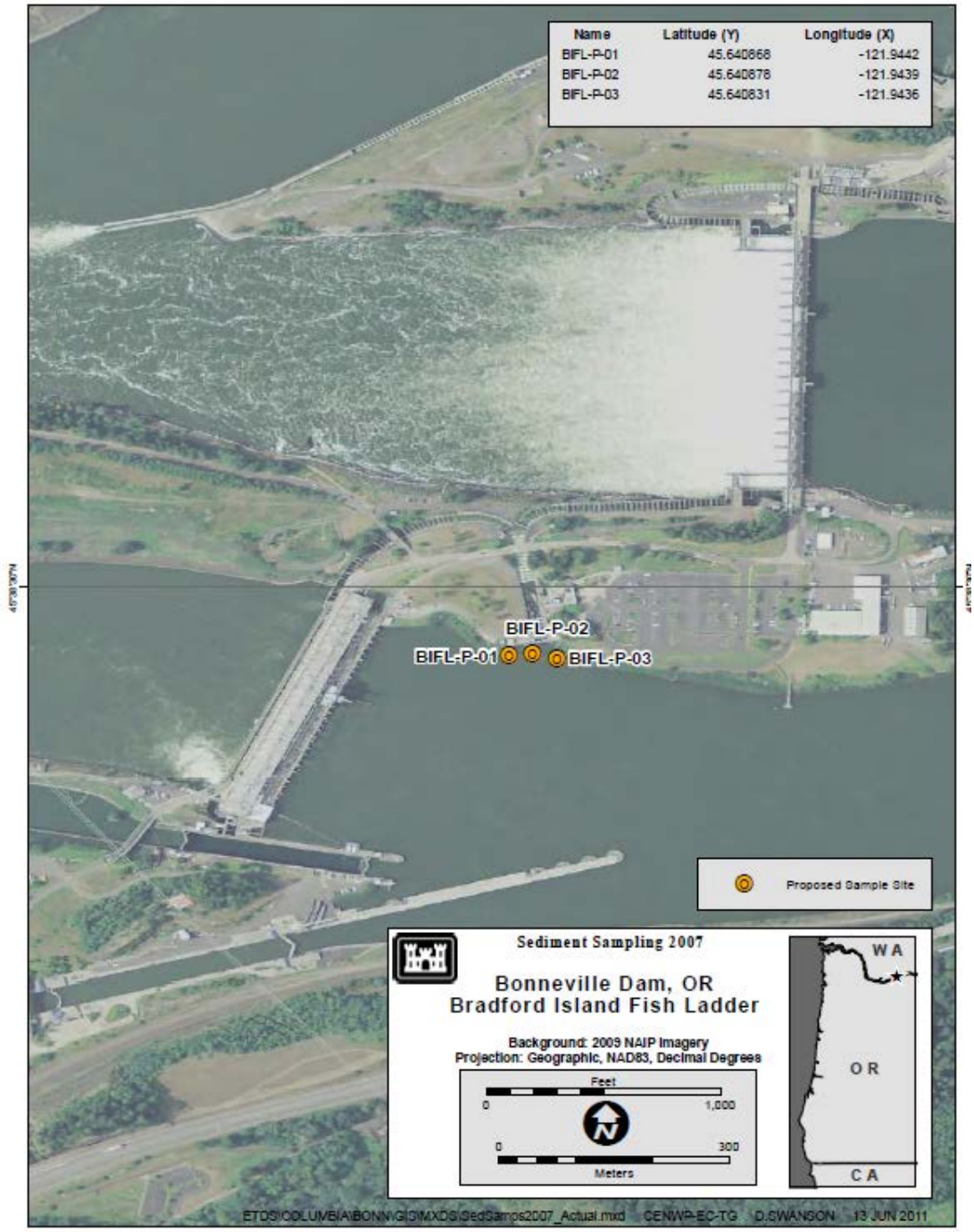
Table 12: Polynuclear Aromatic Hydrocarbons (PAHs) High Molecular Weight - EPA Method 8270C (ug/kg)

Sample I.D.	Benzo(a)-anthracene	Benzo (b) fluor-anthene	Benzo (k)-fluor-anthene	Benzo-(g,h,i)-perylene	Chrysene	Pyrene	Benzo(a)-pyrene	Indeno-(1,2,3-cd)-pyrene	Dibenzo (a,h) anthracene	Fluor-anthene	Total High PAHs
073107BFL-P-01	**5.3J**	**7.7J**	**5.2J**	<9.8	**7.6J**	**8.6J**	**5.5J**	<9.8	<9.8	**10**	**49.9**
073107BFL-P-02	<9.9	**2.9J**	<9.9	<9.9	<9.9	<9.9	<9.9	<9.9	<9.9	**3.6J**	**6.5**
073107BFL-P-03	<9.9	**3.8J**	<9.9	<9.9	**3.2J**	**4.2J**	<9.9	<9.9	<9.9	**4.7J**	**15.9**
SEF (SL)	4300	600		4000	5900	8800	3300	4100	800	11,000	31,000

Symbol (<) = Non-detect (ND) at the value listed (Method Detection Limit).
J=The result is an estimated concentration that is less than the MRL but greater than or equal to the MDL.
B=The analyte was found in the associated method blank at a level that is significant relative to the sample result.

Figure 1: Bonneville, Bradford Island Fish Ladder, Vicinity Map

Figure 2, Bonneville, Bradford Island Fish Ladder, Sediment Sampling Station Locations



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ATTACHMENT C

Dredging Project Review Group Technical Memorandum Re: Review of the July 2011 Level 2 "Bonneville Bradford Island Fish Ladder Sediment Evaluation Report"

29 July 2011

CENWP-EC-HR July 29, 2011

Memorandum for: Portland District, Engineering and Construction Division, Hydraulics and Hydrology Branch, Sediment Quality Group (CENWP-EC-HR – Briner)

Subject: Dredging Project Review Group Technical Memorandum Re: Review of the July 2011 Level 2 *Bonneville Bradford Island Fish Ladder Sediment Evaluation Report* (SQER).

Reviewers: The following summary reflects the consensus determination of the Portland District Dredging Project Review Group (PRG) agencies (U.S. Army Corps of Engineers, Environmental Protection Agency, National Marine Fisheries Service, Washington Department of Ecology, and Oregon Department of Environmental Quality) re: the suitability of project sediments for unconfined, aquatic placement per the 2009 *Sediment Evaluation Framework for the Pacific Northwest* (SEF). This determination does not constitute final agency approval of the project. Project reviewers included: James McMillan (Corps), Jim Turner (NMFS), Laura Inouye (Ecology), Peter Anderson (DEQ), and Jonathan Freedman and Bridgette Lohrman (EPA). U.S. Fish and Wildlife Service did not review the document.

Applicable Authorities Governing the Project: Bonneville Project Act (16 USC 832); Pacific Northwest Power Act (16 USC 839); Water Resources Development Act, Section 511 (Columbia River Fish Mitigation Project); Section 7 of the Endangered Species Act; Section 305 of the Magnuson-Stevens Act; et al.

Project Description: Bonneville Dam is located between River Mile (RM) 145 and 146 of the Columbia River. The proposed dredge site is located at the fish exit (water entrance) of the fish ladder east of the Bonneville Dam First Powerhouse on the south side of Bradford Island. Approximately 2000 cubic yards (or less) will be dredged by clam shell. As a management option, material will be placed at an approved upland disposal site. However, in-water placement is being evaluated in the range of alternatives.

Management Area Ranking/ Recency: Based on the summary provided by the SQER, a moderate management area ranking is appropriate for the project. Sediment chemistry results presented in the SQER indicate that the project contains mercury (Hg) concentrations above the SEF freshwater benthic toxicity screening levels. Additionally, Hg is a bioaccumulative chemical of concern (BCoC).

Sampling and Analysis Description: On July 31, 2007, the Corps collected three Ponar grab samples at the fish ladder exit (upstream of the Bonneville Dam). All samples were submitted for physical analyses including total volatile solids and were, also, analyzed for metals (9 inorganic), total organic carbon, pesticides and polychlorinated biphenyls, phenols, phthalates, miscellaneous extractables, and poly-nuclear aromatic hydrocarbon.

Results: The 2007 physical analyses resulted in mean values of 5.8% gravel (0.4% to 12.8% range), 36.3% sand (23.2% to 28.8% range), and 51.9% silt/clay (15.9% to 71.8% range), with 5.20% volatile solids (4.63% to 5.74% range).

The chemical analyses (see Tables 3, 4, and 5 of the SQER) indicate only very low levels of contamination in any of the samples, with all levels below their respective SEF freshwater screening levels (SLs), with the exception of Hg, which averaged 0.362 mg/kg (ppm) (range 0.319 ppm to 0.402 ppm), exceeding the SEF screening level of 0.280 ppm.

Discussion: Mercury is a BCoC, and evaluation of its presence or absence in projects is essential. The 2007 data indicate that Hg is above the applicable freshwater, benthic toxicity screening levels. Quality assurance review of the laboratory data indicate that the Hg concentrations reported by the Corps were definite detections, above the method reporting limit for the analyses.

Suitability Determination: Material dredged from the Bonneville Dam fish ladder exit is not suitable for unconfined, aquatic placement without additional biological testing. Mercury contamination occurred at concentrations above the freshwater SL in all of the samples. Biological testing should be coordinated with the PRG.

Contact: This memorandum was prepared by James McMillan (CENWP-EC-HR). If the Civil Works Project Manger or Corps Sediment Quality Specialist has questions regarding this memorandum, please call James McMillan at (503) 808-4376 or e-mail to: james.m.mcmillan@usace.army.mil.

James M. McMillan
Lead, Portland District Dredging Project Review Group

References:

U.S. Army Corps of Engineers, U.S. Environmental Protection Agency, Washington Department of Ecology, Washington Department of Natural Resources, Oregon Department of Environmental Quality, Idaho Department of Environmental Quality, National Marine Fisheries Service, and U.S. Fish and Wildlife Service. 2006. *Interim Final Sediment Evaluation Framework for the Pacific Northwest*. Published September 30, 2006, by the U.S. Army Corps of Engineers, Northwestern Division, 194 pp + Appendices.

U.S. Army Corps of Engineers, U.S. Environmental Protection Agency, Washington Department of Ecology, Washington Department of Natural Resources, Oregon Department of Environmental Quality, Idaho Department of Environmental Quality, National Marine Fisheries Service, and U.S. Fish and Wildlife Service. 2009. *Sediment Evaluation Framework for the Pacific Northwest*. Published May 2009, by the U.S. Army Corps of Engineers, Northwestern Division, 128 pp + Appendices.

Figure 1. Bonneville Dam, Bradford Island Fish Ladder Location Map (Columbia River Miles 145-146).

Figure 2, Bonneville, Bradford Island Fish Ladder, Sediment Sampling Station Locations

ATTACHMENT D

2009 *Sediment Evaluation Framework for the Pacific Northwest*

Chapter 10 (Special Evaluations), Section 10.3 (Elutriate Testing)

Elutriate Test Trigger Calculations and Tables for Freshwater Sediment

10.2.4. Federal State Risk Assessment Guidance

In addition to the state-specific guidance cited above, the following EPA and Corps documents may also be consulted for additional guidance on risk assessment procedures and parameters.

EPA. 1998. Guidelines for Ecological Risk Assessment. EPA/630/R095/002F. U.S. Environmental Protection Agency, Risk Assessment Forum, Washington, DC. Available at http://cfpub.epa.gov/ncea/cfm/recordisplay.cfm?deid=12460.

EPA. 1989a. Risk Assessment Guidance for Superfund, Volume 1 – Human Health Evaluation Manual, Part A, Interim Final. EPA/540/1-89/0002. Publication 9285.7-01A. Office of Emergency and Remedial Response, Washington D.C. Available at http://www.epa.gov/oswer/riskassessment/ragsa/pdf/rags-vol1-pta_complete.pdf.

EPA. 1997. Ecological Risk Assessment Guidance for Superfund: Process for Designing and Conducting Ecological Risk Assessments (interim final). Environmental Response Team, Edison, NJ. Available at http://www.epa.gov/oswer/riskassessment/ecorisk/ecorisk.htm.

Corps. 1999. Risk Assessment Handbook Volume I: Human Health Evaluation. EM 200-1-4. Available at http://www.usace.army.mil/publications/eng-manuals/em200-1-4/toc.htm.

Corps. 1996b. Risk Assessment Handbook Volume II: Environmental Evaluation. EM 200-1-4. Available at http://www.usace.army.mil/publications/eng-manuals/em200-1-4vol2/toc.htm.

Cura, J.J., Heiger-Bernays, W., Bridges, T.S., and D.W. Moore. 1999. Ecological and Human Health Risk Assessment Guidance for Aquatic Environments. Technical Report DOER-4, Corps of Engineers' Engineer Research and Development Center, Dredging Operations and Environmental Research. Available at http://el.erdc.usace.army.mil/dots/doer/pdf/trdoer4.pdf.

10.3. ELUTRIATE TESTING

Water quality effects caused by the introduction of sediment and sediment-associated contaminants into the water column must be considered at the point(s) of dredging and point(s) of disposal, as applicable. Laboratory elutriate tests, designed by the Corps Environmental Laboratory at the Engineering Research and Development Center (ERDC; see below), are used to predict water quality effects during dredging and disposal activities, particularly when contaminated sediments are being disturbed as part of the proposed activities.

Water column effects caused by dredging and related in-water construction activities (e.g., capping, disposal) are intermittent, discontinuous, and relatively short-lived. Therefore, water column effects associated with these activities and simulated by elutriate tests do not pose a long-term bioaccumulation concern (EPA/Corps 1998c). Dredging residuals, on the other hand, may contribute to long-term site risk, potentially including bioaccumulation risk if residuals deposits are sufficiently thick and extensive (Bridges et al., 2008). Dredging residuals are generated when contaminated sediments are resuspended during dredging and redeposited on the surface of the project area where they may continue to be exposed to the aquatic community after the construction work is completed. Dredging residuals are discussed in Section 10.4.

10.3.1. Water Quality at the Dredging Site

Water quality effects at the point of dredging are evaluated using a dredging elutriate test (DRET; Di Giano et al., 1995) in conjunction with chemical partitioning calculations. As an initial screening evaluation, sediment concentrations that are not expected to cause adverse water quality effects when resuspended at the point of dredging may be estimated using EPA National Recommended Water Quality Criteria (http://www.epa.gov/waterscience/criteria/wqctable), equilibrium partitioning rules, and agency-recommended partitioning coefficients, as specified in EPA guidance documents (EPA 1996; 2002a, b; 2003 a, b, c; 2005). Level 2B secondary water quality criteria derived by the Oak Ridge National Laboratory (ORNL 1997) were used if National Recommended Water Quality Criteria were not available.

Bulk sediment concentrations derived in this manner may be used as guidance values to determine when DRET testing is required during site characterization (i.e., elutriate testing triggers). A summary of relevant water quality criteria, EPA-recommended partitioning coefficients, and elutriate testing triggers are compiled in Table 10-1 (freshwater) and Table 10-2 (marine). Dredging of bulk sediment concentrations below the elutriate testing trigger values would not be expected to exceed water quality criteria at the dredging site.

Elutriate testing triggers for metals are derived using the following equation:

$$\mathbf{ET_{metal} = K_d \times WQC}$$

where:

K_d is the metal partitioning coefficient in L/kg.
WQC is the acute water quality criterion in µg/L.

The calculation of elutriate testing triggers for organic constituents is modified in two important ways. First, the equilibrium partitioning coefficients are a function of the organic carbon content of the sediments:

$$\mathbf{K_d = K_{oc} \times foc}$$

where:

K_{oc} is the organic carbon-partitioning coefficient in L/kg-oc.
foc is the decimal fraction of organic carbon in kg-oc/kg-sed.

Second, because organic constituents are regulated on a "total" basis (whereas metals are regulated on a "dissolved" basis), both the dissolved and the particulate fractions of the water column concentration should be considered.

$$\mathbf{WC_{total} = WC_{diss} + WC_{part}}$$
$$\mathbf{WC_{diss} = SED_{bulk} / K_d}$$
$$\mathbf{WC_{part} = SED_{bulk} \times TSS_{inc} \times 10^{-6}}$$

where:

WC_{total} WC_{diss} and WC_{part} are the total, dissolved, and particulate water column concentrations in µg/L, respectively.

SED_{bulk} is the bulk sediment concentration in the dredge prism in µg/kg.
TSS_{inc} is the incremental added mass of suspended solids in the water column generated by the dredging action in mg/L.
10^{-6} is a conversion factor of milligrams per kilogram of sediment.

Rearranging these equations, solving for SED_{bulk}, and setting WC_{total} to the applicable WQC yields the following equation for deriving elutriate testing triggers for organic constituents:

$$\mathbf{ET_{organic} = WQC / [(TSS_{inc} \times 10^{-6}) + (K_{oc} \times foc)^{-1}]}$$

In Tables 10-1 and 10-2, elutriate testing triggers for organics are presented for a range of sedimentary organic carbon contents (examples are provided for 1 percent and 5 percent TOC) and dredging-induced TSS concentrations (examples are provided for 10 mg/L and 100 mg/L TSS). The site-specific TOC content is determined from chemical analysis of the dredge prism, as discussed in Chapter 6. The site-specific TSS concentrations generated by the dredging action may be predicted using computer models, as discussed in Section 10.3.3. The range of TSS concentrations used in these tables was derived from a literature survey of TSS concentrations measured during various dredging projects, as compiled by the Los Angeles Contaminated Sediments Task Force (2003). The TSS concentrations at distances of 100 to 300 feet from the dredges, which is consistent with typical mixing zone dimensions, ranged from about 10 mg/L to 100 mg/L. If significantly different TOC or TSS concentrations are expected at the project site, partitioning calculations should be modified accordingly.

Elutriate testing triggers derived in this manner are expected to be conservatively protective for the following reasons:

- The contaminant mass on the sediments is assumed to be an infinite source. In reality, as the mass on the sediment particles is depleted through desorption to the water column, decreasing equilibrium concentrations will be observed in both water and sediments.
- When sediments are resuspended during dredging, equilibrium concentrations in the water column are assumed to be achieved instantaneously. In reality, sediment desorption kinetics may delay the achievement of equilibrium, causing water column concentrations to be less than their theoretical maximum values.
- Equilibrium water column concentrations are estimated for the point of dredging. Typically, contaminant concentrations are further attenuated to between one-half and one-tenth of their initial values as a result of mixing within the construction zone, between the dredge and the water quality point of compliance (see Section 10.3.3).

Table 10-1. Elutriate Testing Triggers for Freshwater Sediment

METALS

Chemical	Acute WQC (µg/L)[a]	Reference	Log Kd (Log-L/kg)	Reference	Elutriate Testing Trigger (mg/kg)
Metals (mg/kg)					
Arsenic	340	[1]	4.0	[2]	3,400
Cadmium	2.0	[1]	4.7	[2]	100
Chromium	570	[1]	5.1	[2]	71,759
Copper	13	[1]	4.7	[2]	652
Lead	65	[1]	5.6	[2]	25,877
Mercury	1.4	[1]	5.3	[2]	279
Nickel	470	[1]	4.6	[2]	18,711
Silver	3.2	[1]	4.9	[2]	254
Zinc	120	[1]	5.1	[2]	15,107

ORGANICS

					TOC (%) =	1%	1%	5%	5%
					TSS (mg/L) =	10	100	10	100
Chemical	**Acute WQC (µg/L)**	**Reference**	**Log Koc (Log-L/kg)**	**Reference**		**Elutriate Testing Trigger (µg/kg)**	**Elutriate Testing Trigger (µg/kg)**	**Elutriate Testing Trigger (µg/kg)**	**Elutriate Testing Trigger (µg/kg)**
Polynuclear Aromatic Hydrocarbons (µg/kg)									
Naphthalene	807	[3]	3.30	[3]		16,099	16,070	80,429	79,714
Acenaphthylene	1,277	[3]	3.17	[3]		18,885	18,860	94,371	93,748
Acenaphthene	233	[3]	3.94	[3]		20,276	20,118	101,027	97,233
Fluorene	162	[3]	4.14	[3]		22,331	22,058	111,045	104,592
Phenanthrene	79	[3]	4.49	[3]		24,338	23,682	120,209	105,730
Anthracene	87	[3]	4.46	[3]		25,019	24,388	123,672	109,644
2-Methylnaphthalene	300	[3]	3.79	[3]		18,486	18,384	92,205	89,723
Fluoranthene	30	[3]	5.00	[3]		29,703	27,273	142,857	100,000
Pyrene	42	[3]	4.84	[3]		28,857	27,177	140,427	107,945
Benz(a)anthracene	9.2	[3]	5.58	[3]		33,696	25,342	146,952	60,286
Chrysene	8.3	[3]	5.62	[3]		33,216	24,420	143,161	56,090
Benzofluoranthenes (b+k)	2.7	[3]	6.18	[3]		35,494	16,258	116,310	23,849
Benzo(a)pyrene	4.0	[3]	6.00	[3]		36,364	20,000	133,333	33,333
Indeno(1,2,3-c,d)pyrene	1.2	[3]	6.61	[3]		34,735	9,635	80,486	11,438
Dibenz(a,h)anthracene	1.2	[3]	6.60	[3]		34,170	9,591	79,873	11,426
Benzo(g,h,i)perylene	1.8	[3]	6.40	[3]		36,137	12,875	100,211	16,673
Chlorinated Hydrocarbons (µg/kg)									
1,4-Dichlorobenzene	180	[4]	3.36	[5]		4,123	4,114	20,594	20,384
1,2-Dichlorobenzene	260	[4]	3.37	[5]		6,094	6,081	30,439	30,122
1,2,4-Trichlorobenzene	700	[4]	3.94	[5]		60,914	60,441	303,516	292,116
Phthalates (ug/kg)									
Diethyl phthalate	1,800	[4]	2.46	[5]		5,191	5,190	25,953	25,919
Di-n-butyl phthalate	190	[4]	4.53	[5]		64,163	62,270	316,539	275,266
Bis(2-ethylhexyl) phthalate	X	[1]	7.18	[6]		X	X	X	X
Miscellaneous Semivolatiles (µg/kg)									
Pentachlorophenol	19	[1]	2.77	[6]		112	112	559	558
Dibenzofuran	66	[4]	4.00	[5]		6,593	6,535	32,836	31,429

Table 10-1 (continued). Elutriate Testing Triggers for Freshwater Sediment

ORGANICS					**TOC (%) =**	1%	1%	5%	5%
					TSS (mg/L) =	10	100	10	100
Chemical	**Acute WQC (µg/L)**	**Reference**	**Log Koc (Log-L/kg)**	**Reference**		**Elutriate Testing Trigger (µg/kg)**	**Elutriate Testing Trigger (µg/kg)**	**Elutriate Testing Trigger (µg/kg)**	**Elutriate Testing Trigger (µg/kg)**
Pesticides (µg/kg)									
p,p'-DDD	0.19	[4]	6.00	[6]		1,727	950	6,333	1,583
p,p'-DDE			6.65	[6]					
p,p'-DDT	1.1	[1]	6.42	[6]		22,908	7,970	62,487	10,223
Aldrin	3.0	[1]	6.39	[6]		59,127	21,316	165,311	27,740
Chlordane	2.4	[1]	5.08	[6]		2,851	2,576	13,609	9,011
Dieldrin	0.24	[1]	5.28	[7]		449	384	2,088	1,171
Heptachlor	0.52	[1]	6.15	[6]		6,436	3,045	21,524	4,555
gamma-BHC (Lindane)	0.95	[1]	3.67	[5]		44	44	222	217
Total PCBs	2.0	[8]	5.49	[6]		5,995	4,722	26,767	12,142
Tributyltin[3/]									
TBT dry weight (µg/kg)	0.46	[1]	4.40	[9]		115	113	571	513

Notes:

[a] Water quality criteria for some metals (Cd, Cr, Cu, Pb, Ni, Ag, Zn) are based on an assumed hardness of 100 mg/L; these criteria should be adjusted to the site-specific hardness of the receiving water, as per Reference [1].

References:

[1] EPA National Recommended Water Quality Criteria (2006)

[2] EPA 2005, *Partition Coefficients for Metals in Surface Water, Soil, and Waste* EPA-600/R-05/074

[3] EPA 2003, *Equilibrium Partitioning Sediment Benchmarks: PAH Mixtures* EPA-600/R-02/013

[4] Oak Ridge National Laboratory 1996, *Toxicological Benchmarks for...Effects on Aquatic Biota*

[5] EPA 2002, *Equilibrium Partitioning Sediment Guidelines: Nonionic Organics* EPA-822/R-02/042

[6] EPA 1996, *Soil Screening Guidance User's Guide* EPA-540/R-96/018

[7] EPA 2002, *Equilibrium Partitioning Sediment Guidelines: Dieldrin* EPA-822/R-02/043

[8] State of Oregon OAR 340-041, Tables 20 and 33A

[9] EPA Region 10, 1996, *Recommendations for Screening Level for Tributyltin in Puget Sound Sediment*

X = Toxicity data shows DEHP is not toxic to aquatic organisms at or below its solubility limit; see Reference [1]